What is claimed is:

1. A device for audio frequency range expansion for generating a wide frequency band audio signal based on an input narrow frequency band audio signal comprising:

5   a) analog-to-digital converting means for sampling input analog narrow frequency band audio signal at a sampling frequency of substantially four times or more and even number multiple of upper limit frequency, and converting the signal into a digital signal,

b) voiced/voiceless judging means for analyzing the digital signal issued

10   from said analog-to-digital converting means, and distinguishing a voiceless sound section not including vowel from a voiced sound section including a vowel, in the audio signal,

c) aliasing signal generating means for disposing sampled signals on every relevant order of sample point of digital signals issued from said analog-

15   to-digital converting means, replacing the value of the every relevant order of sample point spuriously with zero value, and generating a digital signal spuriously having frequency components of twice as high as the input frequency components of narrow frequency band audio signal and having a frequency spectrum folded the spectrum of the input signal symmetrically at the frequency

20   axis which is the upper limit frequency of input audio signal,

d) a filter for limiting the band of the output signal of said aliasing signal generating means by changing over the low pass filter characteristic to a low cut-off frequency state for the voiced sound section and a high cut-off frequency state for the voiceless sound section, based on the judged result by

25   said voiced/voiceless judging means, and

e) signal converting means for converting a digital signal issued from said filter into an analog signal, and issuing an audio signal of wide frequency

band.

2. The device for audio frequency range expansion of claim 1, further comprising:

a low frequency expander for spuriously restoring the low frequency signal lost by narrowing of frequency band of audio signal,

wherein the spuriously restored low frequency signal is added to the digital signal issued from the analog-to-digital converting means and the digital signal issued from the filter, and both high frequency band and low frequency band are expanded.

3. The device for audio frequency range expansion of claim 2,

wherein the digital signal issued from the analog-to-digital converting means is rectified, the low frequency component corresponding to the tone pitch obtained by this process is extracted by the low pass filter, and the phase and amplitude of the low frequency component are adjusted to restore the low frequency signal spuriously.

4. A device for audio frequency range expansion for generating a wide frequency band audio signal based on an input narrow frequency band audio signal comprising:

a) analog-to-digital converting means for sampling input narrow frequency band audio signal at a sampling frequency of substantially four times or more and even number multiple of upper limit frequency, and converting the signal into a digital signal,

b) voiced/voiceless judging means for analyzing the digital signal issued from said analog-to-digital converting means, and distinguishing a voiceless

sound section not including vowel from a voiced sound section including a vowel, in the audio signal,

c) frequency spectrum folding means for folding frequency spectra , at the symmetry axis of the upper limit frequency of input signal towards the high 5 frequency side, by inverting the polarity of sampled signals on every relevant order of sample point of digital signals issued from said analog-to-digital converting means,

d) a filter for limiting the band of the output signal of said band inverting means by changing over the low pass filter characteristic to a low cut- 10 off frequency state for the voiced sound section and a high cut-off frequency state for the voiceless sound section based on the judged result by said voiced/voiceless judging means,

e) a digital adder for adding the output signal of said filter and the converted digital input signal at a specific ratio, and

15 f) digital-to-analog converting means for converting a digital signal issued from said digital adder into an analog signal, and obtaining an audio signal of wide frequency band.

5. The device for audio frequency range expansion of claim 4, further 20 comprising:

a low frequency expander for spuriously restoring the low frequency signal lost by narrowing of frequency band of audio signal,

wherein the spuriously restored low frequency signal is added to the digital signal issued from the analog-to-digital converting means and the digital 25 signal issued from the filter, and both high frequency band and low frequency band are expanded.

6.   The device for audio frequency range expansion of claim 5, wherein the low frequency signal is restored spuriously by rectifying   the digital signal issued from the analog-to-digital converting means, extracting low frequency component corresponding to the tone pitch obtained by this process by

5   another low pass filter, and adjusting the phase and amplitude of the low frequency component.

7.   A method for audio frequency range expansion for generating a wide frequency band audio signal based on an input narrow frequency band audio

10   signal comprising the steps of:

a) sampling input narrow frequency band audio signal at a sampling frequency of substantially four times or more and even number multiple of upper limit frequency, and converting into digital signal,

b) judging voiced/voiceless of the digital signal for analyzing and

15   distinguishing a voiceless sound section not including vowel from a voiced sound section including a vowel, in the audio signal,

c) aliasing by disposing sampled signals on every relevant order of sample point of digital signals issued from said analog-to-digital converting means, replacing the value of the every relevant order of sample point

20   spuriously with zero value, and generating a digital signal including an aliasing signal spuriously having frequency components of twice as high as the input frequency components of narrow frequency band audio signal and having a frequency spectrum folded the spectrum of the input signal symmetrically at the frequency axis which is the upper limit frequency of input audio signal,

25   d) limiting the band of the digital signal including the aliasing signal by changing over the low pass filter characteristic to a low cut-off frequency state for the voiced sound section and a high cut-off frequency state for the voiceless

sound section based on the judged result by said voiced/voiceless judging step, and

e) converting the digital signal limited in frequency band into an analog signal, and issuing an audio signal.

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8.   The method for audio frequency range expansion of claim 7, further comprising a step of:

spuriously restoring the low frequency signal lost by narrowing of frequency band of audio signal,

10   wherein the spuriously restored low frequency signal is added to the digital signal issued from the analog-to-digital converting means and the digital signal issued from the filter, and both high frequency band and low frequency band are expanded.

15   9.   The method for audio frequency range expansion of claim 8,

wherein the digital signal converted to digital is rectified, the low frequency   component corresponding to the tone pitch obtained by this process is extracted by the low pass filter, and the phase and amplitude of the low frequency component are adjusted to restore the low frequency signal 20   spuriously.

10.   A method for audio frequency range expansion for generating a wide frequency band audio signal based on an input narrow frequency band audio signal comprising the steps of:

25   a) sampling input analog narrow frequency band audio signal at a sampling frequency of substantially four times or even number multiple of upper limit frequency, and converting into digital signal,

b) judging voiced/voiceless of the digital signal issued from the sampling step for for analyzing and distinguishing a voiceless sound section not including vowel from a voiced sound section including a vowel, in the audio signal,

c) folding frequency spectra, at the symmetry axis of the upper limit frequency of input signal towards the high frequency side, by inverting the polarity of sampled signals on every relevant order of sample point of the digital signals issued from said analog-to-digital converting step,

d) limiting the frequency band of the digital signal inverted in the polarity at every relevant order of sample, by changing over the low pass filter characteristic to a low cut-off frequency state for the voiced sound section of input narrow frequency band audio signal and a high cut-off frequency state for the voiceless sound section based on the judged result by said voiced/voiceless judging step

e) adding the digital signal limited in the frequency band and the converted digital input signal at a specific ratio,

f) converting a digital signal issued from said adding step into an analog signal, and obtaining an audio signal of wide frequency band.

11. The method for audio frequency range expansion of claim 10, further comprising a step of:

spuriously restoring the low frequency signal lost by narrowing of frequency band of audio signal,

wherein the spuriously restored low frequency signal is added to the digital signal issued from the analog-to-digital converting step and the digital signal issued from the limiting step, and both high frequency band and low frequency band are expanded.

12.   The method for audio frequency range expansion of claim 11,

wherein the low frequency signal is restored spuriously by rectifying the digital signal issued from the analog-to-digital converting step, extracting low frequency component corresponding to the tone pitch obtained by this

5   process by another low pass filtering step, and adjusting the phase and amplitude of the low frequency component.